

NAVISTAR, INC.		
TMS (TRUCK MATERIAL SPECIFICATION)		NUMBER: TMS-7101
TITLE: Thermoplastic Engine Air Intake System Components		CURRENT REV. Nb.: 1010
		DATE: October 2010
WRITTEN/EDITED BY: Materials Engineering	APPROVED BY: Materials Engineering	SUPERSEDES: Rev 0906 – June 2009
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<i>This specification may involve hazardous materials, equipment, and procedures. This specification does not purport to address all of the safety issues associated with its use. The user is responsible to consult appropriate safety and health practices and to determine the applicability of regulatory limits prior to use.</i>		
Change Notice: Corrected Type 8 F testing requirements by moving to the same testing requirements as Type 8.		
Reference: File: 30-14E	Keywords: Plastic tube, air pipes, air intake pipes/tubes, thermoplastic pipe.	

1.0 APPLICATION

This specification covers plastic parts and components used in engine air intake systems. Materials shown are approved for use in filtered and unfiltered air systems. Materials Engineering should be consulted prior to the selection of a material for any application.

2.0 SCOPE

This specification covers Material, Part, and Assembly Performance Requirements for eight types of material. Quality, Source Approval and Quality Control, Shipping and Identification, Designation on Drawings, Approved Materials, and Engineering Design Guidance are included.

NAVISTAR Type	Description and Application *
Types 1, 3, and 4	These are elastomeric compounds used in applications where vibration or relative movement are anticipated.
Type 2	Not assigned at this time.
Types 5 and 6	These are rigid compounds for use in applications with minimum structural loading.
Type 7	This is a high rigidity type compound for use in applications with higher structural loading or with metal inserts or threaded connectors.
Type 8	These are elastomeric dual durometer compounds co-extruded into a single part and used in applications where vibration or relative movements are anticipated. The soft component is available in 3 different hardnesses, designated as "D", "E", and "F".

* See Engineering Design Guidance, Section A.0.

NOTE: Existing drawings referencing obsolete versions of this specification may indicate obsolete material types/grade classification. These are replaced by new Navistar types as shown below:

OBSOLETE DESIGNATION

Type I, Grade a
Type I, Grade b
Type I, Grade c
Type II, Grade a
Type II, Grade b

REPLACED BY NAVISTAR TYPE

Type 3
Obsolete *
Type 4
Obsolete *
Type 4

*Contact Materials Engineering for selection of replacement material.

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2.1 Restricted Chemical Substances

Effective January 1, 2007, all product supplied to the requirements of this specification must comply with the requirements of the CEMS B-50 specification.

3.0 REFERENCE DOCUMENTS

Unless otherwise specified the latest issue of all referenced standards shall apply. The following Specifications, Standards, and Regulations are referenced in this specification.

Quality Standard <i>ISO 9001 or TS-16949</i>	TMS-1059	ASTM D 709
NAVISTAR Mfg. Standard MS-D-13	TMS-6907	ASTM D 746
NAVISTAR Design Std A-16	TMS-9543	ASTM D 792
NAVISTAR Eng. Std Parts (ESP), Book II, Sect. K	CFR Title 29, Part 1910	ASTM D 955
CEMS DT-4	ASTM D 624	SAE J1344
TMS-1058	ASTM D 638	ASTM D 648
CEMS B-50	TMS-9543	

4.0 MATERIAL REQUIREMENTS

All material types shall meet the minimum property requirements shown in Table 1 and Graph 1.

4.1 Color

Material shall be pigmented black unless otherwise specified on the engineering drawing.

4.2 Part Marking

Parts supplied to the requirements of this specification shall be marked to identify the specific polymeric material that the part is made from. The identification marking shall be in accordance with SAE J1344. Marking is an aid to field repair and aids in the recovery/recycling of the part at its eventual end-of-life.

4.2.1 Additional Marking: When specified on the Engineering drawing, purchase order, or other controlling specification, the part shall also be identified so as to provide traceability to the resin lot/batch, mold and cavity number, manufacturing date, and operator, or other identification as specified.

4.3 Performance Requirements – Duct only

4.3.1 Vacuum Collapse

The vacuum collapse requirement must be met for each part number and shall be requalified for any design change which affects the part number.

4.3.1.1 Method 1: For all material types except Types 8D and 8E, measure the outside dimensions of the part at one or more points and mark the measured points. Install the part onto a test fixture, simulating the installed condition. Both ends of the test part shall be held rigidly with the end-plugs or hose inserted to their design depth. Place the fixture and test part into a forced convection oven and heat soak at 100°C (212°F)* for a minimum of 2 hours. Apply a vacuum of 10kPa (40 inches of water) to the test part for 5 minutes. Measure the outside dimensions at the indicated test points while under vacuum.

4.3.1.2. Method 2: For Type 8D and 8E, measure the outside dimensions of the part at one or more points and mark the measured points. Install the part onto a test fixture, simulating the installed condition. Both ends of the test part shall be held rigidly with the end-plugs or hose inserted to their design depth. Place the fixture and test part into a forced convection oven and heat soak at 100°C (212°F) for a minimum of 2 hours. Apply a vacuum of 10kPa (40 inches of water) to the test part for 5 minutes. Measure the outside dimensions at the indicated test points while under vacuum. After successfully completing vacuum collapse evaluation at given temperature, successive collapse evaluations are to be taken at 10°C increments with 2 hour soak times until part failure. Record temperature at which collapse exceeded requirement. Type 8D and 8E materials shall qualify to 200°C soak temperature.

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4.3.1.3 Required: 20% maximum collapse.

**Note: All parts qualified under this specification prior to Rev.E and previous revisions shall meet an 82°C (180°F) temperature exposure requirement.*

4.3.2 Elevated Temperature Performance

4.3.2.1 Heat Resistance

Type 4 materials are limited to 70°C maximum constant service temperatures. Other types will pass the indicated test requirement.

4.3.2.1.1 Method: Parts are mounted on a fixture simulating vehicle installation and exposed as follows:

4.3.2.1.1.1 Short term: 1 hour at 120° C (100° C for Type 4 materials), (180°C for Type 8D and 8E materials).

4.3.2.1.1.2 Long Term: 336 hours at 150° C (100° C for Type 4 materials); Type 8 and 8F materials shall pass 336 hours at 135° C (except 110° C with an insert molded compressor tap in Type 8 and 8F material), (195°C for Types 8D and 8E material except 170°C with an insert molded compressor tap in Types 8D and 8E material).

4.3.2.1.2 Required

4.3.2.1.2.1 Short Term: Parts shall not deform beyond the part tolerance.

4.3.2.1.2.2 Long Term: Parts shall exhibit no evidence of degradation; some deformation is allowed.

4.3.3 Low Temperature Resistance

4.3.3.1 Bending

Flexible, convoluted ducts shall not crack or break when flexed through full range design flex immediately after exposure to -34° C for four hours.

4.3.4 Cyclic Fatigue – Convoluted, Type 8 ducts only.

4.3.4.1 Method: A block cycle fatigue test shall be performed on a finished assembly in the axial direction of the convolutes at 20° C. The cycle shall consist of two blocks. The first block cycle consists of 120 cycles with 35 mm total displacement. The second block consists of 12,000 cycles with 2.5 mm displacement. A total of 1000 block cycles are to be performed.

4.3.4.2 Required: The duct shall not exhibit any cracks. Duct ends shall remain firmly secured. The finished assembly shall meet the vacuum collapse requirements detailed in Section 4.3.1.

4.3.5 Duct Flexibility – Convoluted, Type 8 ducts only

4.3.5.1 Method: Fixture both ends of the part, attaching one side to an actuator with a load cell and measuring applied load. Position the part in a manner so the bellows section longitudinal axis is in the same orientation as the actuator displacement. The part shall be compressed through a displacement range starting from 0 to + 12.5mm and -12.5mm at a temperature of 70°F. Cycle the part six times before taking a reading.

4.3.5.2 Required: The duct bellow shall not exceed 75 lbs of force.

4.4 Property and Performance Requirements – Duct and Fitting Assembly

Test assemblies shall be made with production materials whenever possible. See TMS-1058 or 1059 for guidance on end/bead configurations. Contact TDTC Chassis Design Engineering for assistance in identifying production parts to be used in the test assembly. Inspect, measure and report the relevant dimensions of the parts used in the test. The test assembly should represent manufacturing assembly

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conditions, lubricants and torque rates as closely as possible. Clamp duct using production clamps and torque values with one test set to the minimum and one test set to maximum of torque. When appropriate, measure and report the residual torque of each fastener. When crimp assembly techniques are used, crimp separate sets of test samples to minimum and maximum crimp diameters.

4.4.1 Air Leakage

4.4.1.1 Method: Use the same procedure as for vacuum collapse as shown in Section 4.3.1, except that the assembly shall replicate production fittings and clamps as closely as possible. Measure leak rate under vacuum.

4.4.1.2 Required: No more than 4.25 ml/sec air loss through the sidewalls and fittings.

4.4.2 Coupling Integrity

4.4.2.1 Method: Subject each assembly to a vacuum of 10 kPa throughout the test cycle indicated below.

Coupling Integrity Test Cycle

Step	Duration [hours]	Condition
1	.5 to 1.0	Ramp from 20°C to 80°C
2	96.0 ± 4	Hold at 80°C
3	1.0 to 2.0	Ramp from 80°C to -40°C
4	4.0 ± 1.0	Hold at -40°C
5	.5 to 1.0	Ramp from -40°C to 80°C
6	4.0 ± 1.0	Hold at 80°C
7	Minor Cycle	Repeat back to step 3 for four iterations.
8	Flex	Flex the assembly ±15°, making ten full flexes in approximately 10 seconds each. Repeat flexes in a perpendicular plane. Evaluate each joint for leakage.
9	Major Cycle	Repeat back to step 1 for two iterations

4.4.2.2 Required: The duct shall not exhibit any cracking anywhere in the assembly. Hose ends shall remain firmly secured. Air leakage shall not exceed 8.5 ml/sec.

4.4.3 Pull Out Strength

4.4.3.1 Method: Hard Plastic Ports (Male type)

4.4.3.1.1 Axial: Mount duct in fixed position. Attach port to actuated load cell and subject to 150 pounds of force along the axis of the port for at least 2 seconds

4.4.3.1.2 Radial: Mount duct in fixed position. At a point (no less than half the length of the port) away from the body of the duct, attach port to actuated load cell. Subject port to 150 pounds of force radially outward from the axis of the port for at least 2 seconds.

4.4.3.2 Method: Soft Plastic Ports (Female type)

4.4.3.2.1 Mount duct in fixed position with production fittings assembled in the port. Attach the mating component to actuated load cell and subject to 50 pounds of force along the axis of the port for at least 2 seconds.

4.4.3.3 Required: The port (both hard and soft) shall remain firmly secured in the duct. Leak rate not to exceed that of coupling integrity.

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